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Don't Judge a Tree by Its Size

Innovative tool sheds new light on tree age, growth rate

Madison, Wis. – A new tool developed by the U.S. Forest Service Forest Products Laboratory (FPL) provides a more accurate look at how trees grow, and may have significant implications in forest management and climate-change studies.

Developed by FPL engineer Tim Scott and colleagues David Vahey and JunYong Zhu, the Ring Profiler can reliably determine the anatomical properties of trees from small core samples. This allows researchers to more accurately determine a tree's age, how much it grows each year, and to calculate its mass accumulation.

The ability to accurately calculate mass distribution is valuable in terms of forest management and restoration practices. Regarding global climate change, for example, there is considerable interest in knowing the growth rate of trees in order to calculate the rate at which trees sequester carbon or function as carbon sinks.

Current inventories of forest biomass are based on forest stand density and measurements of the circumference of individual trees. However, while working on a project in a severely overcrowded forest near Bend, Ore., Scott and his team observed such physical measurements may not accurately reflect forest health and tree vigor in suppressed-growth forests.

"What we assumed by looking at the exterior of a tree did not always match up to what we found once we were able to study the tree's rings," says Scott.

The forest consisted of roughly 1,000 trees per acre, about 10 times the desired number of trees for a healthy, productive forest. Scott and his team observed that these century-old trees varied widely in size, from as small as five-inches in diameter to over two-feet in diameter. The smallest diameter trees exhibited extreme growth suppression, adding as little as ¼-inch of radial growth over several decades. A healthy, vigorous tree can add the same in just one year. Surprisingly, they found that even the largest trees sampled exhibited growth suppression in the last couple of decades.

Studying a tree's rings can provide a fairly accurate determination of how old a tree is and how much mass it accumulates over time, but when there are 50 or more rings within a half-inch section, making such determinations can be difficult. The Ring Profiler allows a more accurate look at these extremely tight growth rings.

The tool works by illuminating samples from the sides, allowing the wood cells to act like fiber optic conductors. Light is internally reflected within the cell walls, producing a bright, high-contrast image of the cellular anatomy when viewed from above.

“Side illumination is the key to this invention,” says Scott. “The clear, high-contrast images obtained by the ring profiler can be used in conjunction with image analysis software to calculate the shape and width of the cells, the thickness of the cell walls, and the proportional area of the sample occupied by cell mass. Subsequently, if the density of the cell wall is known or can be estimated, a calculation of local wood density can also be made.”

Scott’s team is now working on automating the process. Their ultimate goal is to develop a laboratory instrument that could be used by forest managers to more accurately assess the growth characteristics and carbon sequestration potential for trees and to improve forest health and aid in restoration efforts. Scott and his team have patented the Ring Profiler and are interested in finding an industrial cooperator for product development.

For over 100 years, FPL’s work with academia, industry, and other government agencies has led to ground-breaking discoveries with great benefit to the public. Additional information on FPL's research is available at www.fpl.fs.fed.us.

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